The World's First Industrial Field Test of a High-Temperature Superconducting Cable System

Southwire Company recently dedicated the world's first high-temperature superconductor (HTS) power delivery system to provide power for industrial use. The system was dedicated on February 18, 2000, at Southwire's manufacturing plant in Carrollton, Georgia, USA.

The system, which includes three 30-meter long HTS power distribution cables, provides electricity to three Southwire manufacturing plants. It is the first time a company has made the difficult transition from laboratory testing to a practical field application.

"As the global population continues to boom and the world economy grows, those involved in the distribution of electricity will have to explore new ways of delivering power to blossoming customer bases," said Roy Richards, Jr., Southwire's chief executive officer. "Southwire is proud to play a role in the development of one of those alternatives."

An overhead view of the cable test sight at Southwire Company in Carrollton, Georgia. This is the world's first high-temperature superconductor power delivery system to provide power for industrial use. The system was dedicated on February 18, 2000.

A high point of the dedication came when distinguished guests—U.S. Secretary of Energy Bill Richardson and Georgia Governor Roy Barnes—helped Richards throw a series of switches that activated the system.

"This is an exciting step toward the first practical deployment of superconducting technology, which promises to do for electric transmission what fiber optics is doing for communication," Richardson said. "These cables, developed through a partnership with the Energy Department and the private sector, will move large amounts of electricity using the same space or less space than traditional cable, increasing energy efficiency, enhancing grid reliability. and reducing costs for businesses and consumers."

Nearly immune to resistance, superconducting power cables lose only about a half-percent of power during transmission, compared to 5 to 8 percent lost by traditional power cables. HTS cables also deliver more power per unit area—about three to five times more power than traditional power cables.

As the rapid growth of urban areas increases demand for electricity, while limiting the space for overhead and underground cable installations, the ability of HTS cables to transmit more power using the same amount of space as traditional cable will be increasingly important. Although they are not likely to replace high-voltage overhead lines, HTS cables can be used underground in areas where more power is needed but space for additional lines is not available.

HTS cables also could be used to construct power-distribution rings around moderate-sized cities, where lower-capacity cables could tap in and carry power to customers throughout the community.

"For years, superconductors have represented the promise of more energy- efficient and cost-effective electrical power delivery," Richards said. "The live installation of this HTS system is a giant step forward in making that promise a reality."

Southwire's partners include the U.S. Department of Energy, which co-funded the project, and Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory. Industrial partners include Intermagnetics General Corporation and EURUS Technologies, Inc. Electrical utility partners include Southern Company, Georgia Transmission Corporation, and Southern California Edison. The world market for HTS materials is estimated to be $30 billion by the year 2020.

"The installation of these load-bearing cables makes Southwire one of the world leaders in superconducting technology development," said R.L. Hughey, Southwire's superconductor project manager. "We're proud of this groundbreaking achievement and we're excited about being able to bring our customers the benefit of this leading-edge technology that will be capable of handling the power demands of the new century."

Southwire's cables carry as much as 1,250 amperes at 12.4 kilovolts. The cables are insulated with Southwire's proprietary cryogenic dielectric tape material, "Cryoflex." The cables can carry enough electricity to power the entire city of Carrollton, Georgia.

ORNL's contribution includes the work of three divisions: Fusion, Life Sciences, and Energy. ORNL and Southwire formed a cooperative research and development agreement in 1995 and began testing prototype cables ranging from 1 to 5 meters long.

"They (Southwire) built the prototype cables and we tested them," said John Stovall, ORNL's project manager for superconducting cable. "We then worked together to develop the new technology leading to the 30-meter cable demonstration."

The Fusion Energy Division developed the HTS cables and terminations, and performed high-current and high-voltage tests on the prototype 5-meter cables at ORNL's test facility. The Laboratory's Life Sciences Division conducted high-voltage tests of the cable dielectric.

"You have to have electrical insulation that will work at cryogenic temperatures in liquid nitrogen at high pressure and at high voltage," said Isidor Sauers of the Life Sciences Division, who worked on the project. "We used Southwire's Cryoflex tape insulation for the testing.

Mike Gouge of Fusion Energy noted the prototype cable for the Southwire facility was developed at the Fusion Energy Division facilities at the Y-12 Site. Southwire employees in the superconductivity area trained at ORNL, and Laboratory personnel helped with testing and commissioning the 30-meter cable system at the Southwire facility in Carrollton.

"It has been a pleasure working with a results-oriented company," said Bob Hawsey, manager of ORNL's Superconductivity Program. "Southwire made development of superconducting cable knowledge a high priority from day one."

With annual sales of US $1.4 billion, Southwire Company is one of the leading wire and cable manufacturers. Southwire technologies and products, including building wire and cable, copper and aluminum rod, and utility cable products, are distributed to countries worldwide. Southwire's world headquarters is in Carrollton, Georgia, USA, about 40 miles west of Atlanta. Founded in 1950 by Roy Richards, Sr., the company celebrated its 50th anniversary in March 2000.